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Lessons Learnt from the Energy Needs Assessment carried out for the Biogas Program for Rural Development in Yogyakarta, Indonesia

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Abstract

This paper briefly presents the experience of the Center for Regional Energy Management in the needs assessment, capacity building and adoption of household biogas plants in rural areas of Yogyakarta over the past five years. The biogas program has been designed to solve specific energy provision problems in rural areas, such as securing cooking fuel, as well as to promote ecological farming by using biogas digester as organic manure, thereby efficiently recycling locally available biomass waste. The paper also points that realizing these goals would require significant changes in funding and policy support for the successful implementations of biogas in developing countries. In addition, it highlights some of the key issues related to the implementation of rural energy programs and suggests a new approach and future strategies for initiatives that endeavor to address the issue of rural poverty and improve the living conditions of rural people.

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Keywords: biogas; renewable energy; needs assessment; energy policy

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1. Introduction

Indonesia has abundant supplies of renewable energy sources. As an agricultural country, it produces significant amounts of biomass and biomass waste that represent a particularly important source of energy. Based on Ministry of Energy and Mineral Resources data, the biomass energy potential from the three sectors of forestry, agriculture and estates, e.g., palm, cassava, etc. is estimated to be an equivalent of about 50,000 MW. The potential for solar energy is also relatively good which the solar intensity being about 4.8 kWh/m^2/day. The total geothermal energy potential is around 20,000 MW; this amount of energy is equal to approximately 40 % of the geothermal energy potential resources in the world. Hydropower potential for electricity generation is estimated at around 75,000 MW. On the other hand, the potential for wind energy is generally small with wind speeds ranging of 3 to 5 m/sec. However, in particular areas of the eastern part of Indonesia, the wind speed maybe reach up to 5 m/sec or above.

In order to overcome the energy crisis, i.e., reducing the dependency on oil and increasing the security of energy supply for domestic uses, in 2006, the Government of Indonesia has released Presidential Decree (Regulation) No. 5 on National Energy Policy which sets the target for the national energy mix in 2025, as follows: Oil, maximum 20%; Coal, at least 33%; Gas, at least 30%; Geothermal, at least 5%; Biofuels, at least 5%; Liquefied coal 2% and other new renewable energy, i.e., biomass, nuclear, hydro power, solar, and wind, at least 5%. This policy also aims to reduce energy elasticity to be less than 1 and the national electrification ratio to reach 93% in 2025. In addition, the government has also provided the direct subsidy to the people in cash transfers as a compensation for increasing fuel price.

National energy programs targeting the above are being implemented in several provinces in Indonesia. While there is no detailed national energy policy or program directly concerning on energy poverty alleviation; some energy programs are closely related to increasing the electricity connection or generation in isolated areas or villages. Within terms, isolated areas or villages can be represented as poor community groups or village peoples who only have limited access to energy. Existing programs consist of (1) developing of SHS (solar home system) in underprivileged households in remote areas, (2) biogas for households, (3) Micro/Mini Hydro Power Plant (MHPP) development in remote areas with huge potential for hydro power, etc., which are in line with the energy policy target of increasing rural electrification and development of renewable energy technology in regions. In Yogyakarta Province, some national energy programs have been promoting awareness on renewable and empowering communities for the use of available renewable energy sources for domestic and local needs, such as the energy self-sufficient village program.

Generally, the aim of the regional energy policy in Yogyakarta is to develop sustainable energy programs which consider the social-economic-cultural context and are in line with the economic development in the real sector, labors and people. An energy development strategy implemented in DIY province is known as a Triple Strategy, consisting of three main aims, i.e., Pro-Growth, Pro-Job and Pro-Poor. To implement this strategy, the regional energy office has set up several regional energy programs, including a renewable energy development program. Unfortunately, as with the national programs, there is still no provincial energy program which is directly targeted to improve the energy access of underprivileged communities in an effort to alleviate poverty.

The aim of this study is to formulate a strategy for the implementation of the biogas program for poor rural communities in Yogyakarta. Although many studies already provide a fairly clear picture of the energy-related needs of poor communities in Indonesia, it is still advisable to confirm these with regard to the local specifics in a participative way in the local community, since this is part of the process aimed at enhancing the involvement of the local communities in the energy project.

In order to identify the energy-related needs and priorities of poor communities and develop strategies to address these needs, activities on the study were set up as follows:

1. Conduct energy needs assessment for a limited number of selected energy-poor communities
2. Identify measures to address the identified needs
3. Develop pro-poor energy strategy
4. Develop biogas program based on the rural community participation.

2. Methodology

The participatory rural appraisal method (PRA) was selected as the research approach for the energy needs assessment in selected villages/communities. The PRA is a well-known technique which can be an effective method for analyzing the needs for energy in rural communities. When an energy program such as increasing energy access for poor communities is to be implemented, a market assessment or needs evaluation should be conducted in order to observe which services are actually required from the various energy technologies. Failing to do so often results in a miss-match between actual household energy needs and the supplied technology, and ends up in the technology being underutilized and communities returning to their traditional energy sources. In order to fulfill actual energy needs successfully, the PRA must provide a reliable analysis and assessment. Participation is one of the key principles of community development, particularly in the case of planning energy provision for poor-communities in rural areas that is an essential part of human development and often leads to the development of self-confidence, pride, initiative, creativity, responsibility, and cooperation. Without such development within the people themselves, all efforts to alleviate their poverty will be immensely more difficult, if not impossible.

2.1. Structure of PRA

PRA is an exercise in communication and transfer of knowledge. Regardless of whether it is carried out as part of project identification or appraisal or as part of country economic and sector work, the learning-by-doing and teamwork spirit of PRA requires transparent procedures. For that reason, a series of open meetings (an initial open meeting, final meeting, and follow up meeting) generally frame the sequence of PRA activities. Participatory data collection, or research, is generally associated with qualitative methods of information gathering. Qualitative methods in comparison to quantitative ones tend to be more concerned with words than numbers. Qualitative methods are therefore based on data collection and analysis which focus on interpreting the meaning of social phenomena based on the views of the participants of a particular social reality [1].

Participatory approaches as PRA tools have a variety of data collection methods: (a) participatory listening and observation; (b) visual tools; (c) semi-structured interviews; and (d) focus group discussions. Among the participatory methods of evaluation, semi-structured interviews and focus groups are the most often used instruments for gathering the views of participants on certain topics and issues. In this study, both tools were used in order to analyze the energy needs of rural communities in villages. While quantitative questionnaires are structured in the variety of answers that a respondent chooses from, qualitative surveys and focus groups allow for more nuanced, semi-structured and open-ended responses. The objective of both techniques is to capture values, attitudes and preferences of participants to permeate the 'how' and the 'why' underlying a phenomenon of energy needs and services. What follows is a brief explanation of the semi-structured interview and focus group discussions:

a. *Semi-structured interview*

"Semi-structured interviews – conversations based on a set of guideline questions – are a key technique in participatory research, and a powerful way of learning about the views of older people" [2]. Although all guideline questions will be asked during an interview – albeit with the possibility of varying order – new questions may arise during each interview. Therefore, the interview process is flexible compared with the rigidly structured interviews that we will turn to in the next section. This kind of flexibility will allow the interviewee to describe events, observations and issues in very personal terms and he/she will thus be less restricted to respond to questions in his/her own words. The set of questions however, will ensure comparability of data when the interviews are analyzed.

The guideline questions of the interview should be organized according to topical areas of inquiry that should succeed each other in a logical fashion. The language used should be comprehensible and jargon free. It is obvious that the interviewer has to be able to speak the language of the community in which he/she will conduct semi-structured interviews.

b. *Focus group discussions* (*FGD*)

Focus group discussions are "a research strategy which involves intensive discussion and interviewing of small groups of people, on a given 'focus' or issue, usually on a number of occasions over a period of time" [3]. The difference between individual semi-structured interviews and focus group discussions is that the latter gives an opportunity to follow the group dynamic that evolves during the discussion. How interviewees react to each other's responses and make up their opinion, often as a reaction to what other participants have expressed is of core interest during a focus group discussion. Since participants may argue about certain aspects of an issue that is being discussed during a focus group, the reactions expressed and opinions voiced may be more realistic compared with an individual interview. In addition, views of participants can be challenged by others more profoundly than in a semi-structured interview. Thus, focus group discussions ideally complement semi-structured individual interviews.

The moderator who facilitates the focus group should try to be not too intrusive and should rely on a rather unstructured setting for the discussions to extract the opinions, views and perspectives of the participants. The moderator should have a rather small number of guiding questions to stir the discussion and should intervene minimally. The moderator should record the discussions on audio equipment and make notes on the non-verbal behavior of the participants. Naturally, the main interest would be on the range of opinions expressed, who are the opinion leaders and how.

2.2. Implementation of PRA for Energy Needs Assessment

Some actors have an important role in the success of a PRA. In this study, the key actors of the PRA for energy needs assessment can be categorized into two groups, i.e., *Participants*: rural community and local government, *PRA Team and Facilitator*: researchers and regional office of regency. The description of responsibility, function and involvement of each actor is given as follows:

- *Participants.* Local people's input into PRA activities is essential to its value as a research and planning method and as a means for diffusing the participatory approach to development. The participants that attended the PRA activities were the following:
  - Community households, which can be divided into several classes depending on income level or another classification.
  - Local entrepreneurs: the existing local entrepreneurs/home industry, mainly farming or animal breeding.
  - Other local stakeholders such as hamlet chief, village government representative and district government representative.
  - Community stakeholders: community leaders, religion leaders or village representative board).
- *PRA Team and Facilitator.* The team consisted of researchers and a representative from the regional office. The researchers had the responsibility to prepare, design and organize the PRA activities. They also ensured that the validity of PRA data relies on informal interaction and brainstorming among those involved. To this end, the team involved the regional officer with perspective and knowledge on the area's energy supply conditions and potential; and with help by local stakeholders, the technical team should also gather information on traditions, and social structure in the selected area. During the PRA activities, i.e. FGD, the team also provides the facilitator (surveyors) for the interview and moderator with instructions on how to guide the discussion within rural community.

In order to capture the specific social reality of energy needs in the selected villages/locations, a comprehensive research design based on a combination of quantitative and qualitative methods was constructed. Data collected by quantitative research methods is rarely sufficient to provide a full explanation of such issues i.e. the observable social and economic issues in selected villages. The quantitative data can be collected from several sources, i.e., village monographic data and statistical data from Regency/Regional Statistical Central Bureau. Integrating quantitative analysis with qualitative methods is important to provide policy makers with a comprehensive portrait of the socio-economic situation and problems of various social groups. Such an integrated approach would also be of use in reviewing and appraising the energy needs assessment. Figure 1 shows the sequence of steps used in the energy needs assessment and energy strategy formulation.

The PRA survey was conducted in the villages of Segoroyoso and Wirokertenin Bantul Regency, Yogyakarta Province. The semi-structured interviews were conducted in flexible form based on a set of guidelines. This flexibility allowed the interviewee to describe selected issues in detail and could also generate new questions (outside of guidelines) on unconsidered issues. The survey was carried out during visits to select cluster communities, local stakeholders, local entrepreneurs and community groups. Information was collected during the survey (semi-structured interview) and focus group discussion on the following issues:

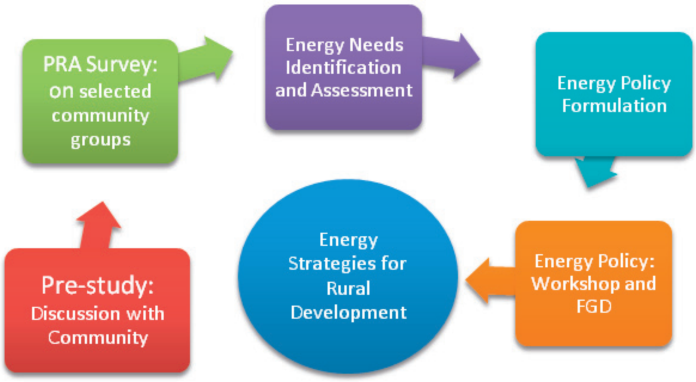

Fig. 1 Energy needs assessment and strategies using PRA method

- HOUSEHOLDS
  1. Types of energy currently used for domestic activities, community services and by the local entrepreneurs;
  2. Current energy problems encountered when conducting household activities;
  3. Energy needs, current energy sources used and theirconsumption (and cost);
  4. Available energy sources in the neighbourhoods and nearby;
  5. Understanding of renewable energy potentials and sources possibly available in village;
  6. Willingness to pay/invest in energy solutions.
- LOCAL ENTREPRENEURS
  1. Current energy related problems;
  2. Energy needs and current energy supply and its cost;
  3. Energy potentials surrounding their village(s);
  4. Ranking of energy needs according to the urgency of a problem for local entrepreneurs;
  5. Understanding of renewable energy potentials and sources possibly available in village;
  6. Willingness to pay/invest inenergy solutions.

Respondents sampled in a semi-structure interview should be determined properly. We use the terminology of "Respondent" for householdand local entrepreneurs. The number of respondents was based on the population size, stratified by income and work classification and then it was called a ***respondent cluster***, as follows:

- Cluster 1 : Low income, household, work: farmer/ services sector
- Cluster 2 : Medium income, household, work: farmer/ services sector with additional income
- Cluster 3 : Medium income, household, work: officer (government)
- Cluster 4 : Medium income, local entrepreneur in various sectors

Respondents (households/local entrepreneurs) would normally be obtained by a random sampling method calculated from the total population in villages. However, due to the large population in selected villages (e.g., Segoroyoso village: 5,601people)[4], the respondents sampling was reduced to the level of hamlet, based on the consideration that the demographic characteristic of each hamlet is similar to that of the village. There are nine hamlets in Segoroyoso village with an average population of 623. By ratio of family size per household (3 people in a household), the required respondents sample size was calculated to be 207 households. Considering the specific error level tolerated is up to 15 % and confidence level should be 90 %, the sample size for the survey should be 26 households per hamlet. With respect to assumed composition of 60 % is living in households and working in agriculture and services sector, and then, they were divided into 3 clusters (cluster 1:2:3). Other 40 % of population is living in households as local entrepreneurs and then, it was categorized as cluster 4. Thus, there are 4 clusters with composition of cluster is 1:2:3:4 or it is equal to 20 %, 30 %, 10 %, 40 % or households population. The number of respondent per cluster can be determined as:

- Cluster 1 : 5 households per hamlet or 45 households per village
- Cluster 2 : 8 households per hamlet or 72 households per village
- Cluster 3 : 3 households per hamlet or 27 households per village
- Cluster 4 : 10 households per hamlet or 90 households per village

The main issues tackled by this analysis were (1) current energy consumption, (2) energy related needs and problems; and (3) energy priorities in rural community. Based on these issues, the results from the PRA were identified, tabulated, analyzed and summarized, as follows:

- What are the energy needs and expenses of the community and businesses in the villages?
- What are the energy priorities listed by the community and businesses in the villages?
- How to formulate several alternative energy policies for selected communities and local entrepreneurs to address the energy needs properly?
- What appropriate renewable energy program should be implemented to meet the identified energy needs?
- How do we design the possible financial/investment scheme for such an energy program's implementation?
- How do we use the willingness to pay (WTP) and ability to pay (ATP) from the community and local entrepreneurs to design the possible financing scheme?

3. Results and Discussion

3.1. Energy Needs Assessment

Table 1 presents the types of energy used in the observed community. All households in the study area have been connected to the national electricity grid, so they use electricity for most of their activities, except for cooking and transportation. Cooking is one of the principal energy uses in households. Although the kerosene to LPG (liquefied petroleum gas) conversion program from the government has been launched in 2008, kerosene is still used for cooking to trigger the fire. Regardless, most households use firewood as the principal energy source for cooking. From the interview, the community is still complaining about the availability of kerosene which is limited and expensive. They said that to use LPG only for cooking is more expensive than using a combination of LPG and firewood. Some others are still afraid of using LPG due to the risk of explosion, known to have occurred to several 3-kg gas cylinders.

Table 1. Summary of energy source provision in selected study villages

Activity (arranged on priority)	Type of Energy				Supply/Source			
	Electricity	Liquid fuels*	Firewood	LPG	Electricity	Fuels	Firewood	LPG
Cooking	-	×	×	×	-	Buy	Buy & Collect	Buy
Lighting	×	×	-	-	On grid	Buy	-	-
Ironing	×	-	-	-	On grid	-	-	-
Transportation	-	×	-	-	-	Buy	-	-
Entertainment	×	-	-	-	On grid	-	-	-
Washing	×	-	-	-	On grid	-	-	-
Sewing	×	-	-	-	On grid	-	-	-
Local Entrepreneurs	×	×	×	×	On grid	Buy	Buy & Collect	Buy

*Fossil fuels, i.e., kerosene, diesel, petrol.

With regard to energy conservation in households and to save on energy-related costs, most respondents have cited using a combination of firewood and gas for cooking purposes. Particularly, local food entrepreneurs, such as those producing the popular "krecek" crackers, are still using firewood as the predominant energy source for their crackers production. Even the high-income household group reported they are also still using this combination of energy sources for their cooking activity. Based on their experiences, the combination of these energy types may reduce the cost of energy for cooking. This indicates that the target of the kerosene to LPG conversion program may be not successfully achieved in this community.

Kerosene is also used for lighting when there is an electricity blackout. Inconsistency of power supply from the grid is also a source of complaints by respondents due to its disturbance to the society activities at night. For local entrepreneurs, such as cattle breeders, the power blackout may result in disrupted works, e.g., delay in cleaning cattle cages since they are still using electric pumps. The consumption of energy by households and local entrepreneurs strongly depends on the gross income. In the case of local entrepreneurs, the production activities are also of course influencing the energy expenses. Table 2 summarizes the average energy expenses per month for every class of respondents.

Table2. Comparison of energy expanses

Household Cluster	Average monthly income	Average Energy expenses	Share of energy expenses relative to income
Cluster 1	IDR 750,000	IDR 325,000	43 %
Cluster 2	IDR 1,500,000	IDR 400,000	16 %
Cluster 3	IDR 2,000,000	IDR 350,000	12 %
Cluster 4	IDR 5 – 10,000,000	IDR 2,500,000	25 %

In 2011 IDR.

As shown in Table 2, the highest percentage of household income spent for energy is about 43 %, which is the case for households in cluster 1, employment as farmers and in the services sector. This means these groups have inadequate or limited income for other household demands, such as food, education, health and entertainment. However, there is a government policy to reduce education and health care costs for poor communities, i.e. the educational subsidy program of BOS program (BOS = school operational grant), and health subsidy in Puskesmas as a center of community/public health is provided in each village. The government has also provided an in-kind subsidy for food through "Raskin" program (*beras miskin* or food (rice) for poor community). Therefore, low-income households may need to spend less money for these demands.

3.2. Willingness to Pay and Ability to Pay for Renewable Energy Program

In the interviews and discussions of the PRA, respondents (households and local entrepreneurs) were asked to describe the possibility of investing in an alternative (renewable) energy installation for their energy needs, and also to estimate the possible monthly payments if a credit scheme is implemented for funding the energy installation. The proposed energy installations are biogas, improved stove for Jatropha oil and SHS (solar home system) which were selected based on the energy use priorities and local renewable energy potentials. For local entrepreneurs, the proposed energy installation was selected based on the main energy source for production, i.e., biogas for cooking. Table 3 presents WTP (willingness to pay) based on the respondent opinion during PRA activities.

Table 3. WTP for alternative (renewable) energy uses for household and local entrepreneurs

Household Cluster	Avg. Possible Investment (in IDR millions)	Avg. monthly payment for credit scheme (in IDR thousands)
Cluster 1	5	20
Cluster 2	8	25
Cluster 3	8	40
Cluster 4	10	50

Some measure of "ability to pay" is typically used by decision-makers in the process of authorizing projects. Similarly, government or NGO commonly use some measure of ability to pay for determining the level of grants and loans to be made available to projects. In general, those projects targeting households with lower levels of income, adjusted for other basic living expenses, can expect to receive a higher level of grant funds and a corresponding lower level of loan funds than projects targeting users with higher levels of adjusted income.

The "ability to pay" analysis is a definition based on the amount that households pay for energy. It is relatively correlated with "residual income." Residual income is defined as the amount remaining from household income after payment of housing costs, such as electrical utilities, gas or other heating utility, mortgage or rent, and water and sewer costs. The equations used to estimate *ability to pay* factors is defined as follows:

$$\text{ability to pay (ATP) factor} = \text{average energy expenditures} \div \text{residual income} \quad (1)$$

$$\text{residual income} = \text{household income} - \text{home payment} - \text{utilities} - \text{insurance and tax} \quad (2)$$

$$\text{design of ATP factor} = \text{average ATP} - 1.28\sigma \quad (3)$$

Table 4 shows the comparison of ATP analysis obtained from percentile analysis and by using the formulation. The ATP analysis is calculated based on the level of income. From this analysis, it can be concluded that, although the community has a low willingness to pay (WTP) for a biogas installation particularly for households in cluster 1 and 2 (Table 3), based on the ATP analysis, it appears that what they can pay based on household income levels is more than IDR 45 thousand.

Table 4. Comparison of ATP analysis from percentile and formulation

Monthly Income	ATP factor	Ability to Pay (IDR/month)	
		Percentile	Formulation
< IDR 1,000,000.00	0.623	60,591.50	37,858.50
IDR 1-2,000,000	0.878	50,726.64	31,694.79
> IDR 2,000,000	0.161	303,296.00	189,504.00
All income classes	0.755	77,956.55	48,708.45

3.3. Cost and Benefit Analysis for Biogas Program

Yogyakarta has renewable energy potential from biogas and biomass. From regional energy profile, the biogas potential calculated from the amount of livestock is about 247,010 cows and biomass from agriculture waste is about 982,623.78 ton/year. Table 5 also shows the biogas and biomass potential which are available in the selected villages, Segoroyoso in 2010.

Table 5. Renewable energy potential in Segoroyosovillage in 2010

Renewable Energy	Sources	Estimated Energy Potentials
Biomass	Agricultural waste	222.46 ha of paddy field
Biogas	Livestock	975 cows, 66 horses, 117 goats, 662 sheeps 6000 chickens

Based on these energy potentials and the results from the needs assessment, alternative energy programs can be proposed. These potential energy programs were designed with consideration to the important issues of (1) the sustainability of the programs which is based on the local cultural and social community, (2) the optimization of the available renewable energy sources, and (3) possibility for quality of life improvement through the energy program. Considering these matters, the most appropriate energy program in selected villages is development of biogas for cooking purpose in household and local entrepreneurs. The program is detailed as:

a. Biogas installation must be in efficient use and low-cost construction based on the capacity of 3 to 4 cows for household level (small construction design) and 5 to 10 cows for local entrepreneur. The fixed-digester reactor was selected for this technical requirement. The estimated cost for constructing the fixed-dome digester reactor with the volume capacity from 4 – 5 m^3 is IDR 5.7 million.
b. Community assistance in terms of transferring the knowledge and implementing the biogas energy program must be provided by government or local NGOs.

The benefit and cost analysis (Table 6) was used to quantify the benefits achieved by a household that installs a biogas digester. The main economic benefits to a household are:

a. Savings from avoided purchases of cooking fuel and
b. Savings from avoided purchases of fertilizer (or revenue from the sale of slurry, in case the household does not use it on its own land).

The economic analysis of a biogas digester is calculated for volume 4 m^3 (from two to three cows). This biogas capacity will meet the cooking needs of a small to medium size family (approximately for 4-6 persons).

Table 6. Benefit and cost analysis for proposed biogas digester

No	Remark	Volume	Unit Price (IDR)	Saving per Month (IDR)	Saving per Year (IDR)
1.	Saving from LPG used, or	3 LPG cylinders/month	14,000	42,000	504,000
2.	Saving from kerosene used	10 liter/month	8000	80,000	960,000
3.	Saving from Firewood	20 sting/month	2000	40,000	Up to 480,000*
4.	Benefit from the use of organic fertilizer (manure)	10 kg/day	250.00	50,000	600,000
		Benefit of using a biogas digester per year instead of using LPG			1,104,000
		Benefit of using a biogas digester per year instead of using firewood			1,080,000
		Benefit of using a biogas digester per year instead of using kerosene			1,560,000
		Construction cost of 4 m^3 biogas digester			5,700,000**

Note : 1 cow can produce 15 kg animal waste per day. Every 12 kg of waste can be used for methane gas which can replace ½ litre of kerosene.*Most households combine wood purchasing with their own collection, which is free. So the actual savings per household will depend on the fraction of purchased wood in total wood use, and will be between 0 (in case all wood is collected) and 40,000/month (in case all wood is purchased, which is unlikely).**In this case, there is no subsidy from Biru on biogas installation cost.

Payback period of the proposed biogas digester compared to LPG is then calculated as energy source for cooking. The calculation is payback period without any subsidy and without any loans with commercial interest. The result is presented in Table 7. It can be concluded that, based on payback period calculation, the investment will be paid off in about 6 years.

Table 7. Pay Back Period Calculation of First Scenario for Proposed Biogas Digester based on Benefit Received by Household which is using LPG as energy source for cooking*

No	Remarks	Investment	Cumulative Savings
1	Investment cost of proposed digester	5,700,000	
2	Saving in Year 1	1,104,000	4,596,000
3	Saving in Year 2	1,104,000	3,492,000
4	Saving in Year 3	1,104,000	2,388,000
5	Saving in Year 4	1,104,000	1,284,000
6	Saving in Year 5	1,104,000	180,000
7	Saving in Year 6**	1,104,000	+(924,000)

*This payback period calculation does not consider the interest of investment and the maintenance of biogas is using local materials.**Payback Period is 6 years.With biogas life time is about 20 – 25 years, which means that after 6^{th} year when the investment is paid off, energy for cooking needs by biogas is free.

Based on the community response, the price of biogas installation is still expensive compared for their daily income. In order to reduce the financial constraints, some solutions may be proposed as follows:

a. The biogas for household program from the government of Indonesia (GoI) can be implemented, for example the BIRU program was established in 2008 or cooperation with financial institutions, e.g.,bank, with available access to soft loan facilities. This program may provide an investment support in the form of a direct subsidy up to IDR 2 million to prospective users per constructed digester.

b. The rural community each household may provide some of the required material as a contribution in kind, so it would be less financially burdensome for a household to pay for the construction of a biogas digester. In addition, it is better to conduct the community assistance for biogas users to avoid the errors on development and at least for 2 years for their actor maintenance. Additionally, the biogas program may also be integrated with the role of rural development from NGOs and government, private-run agricultural sector and live cattle business.
c. The regional energy office also plays an important role in the funding scheme. The office can propose the regional budget for financing the subsidies or pilot program in the selected areas in combination with credit or soft loan from financial institutions.

4. Conclusions

The participatory rural appraisal method was selected as a research method for the energy need assessment in selected villages in Bantul, Yogyakarta Province. The PRA is a well known technique which can be an effective method for analyzing the needs of energy in a rural community. When an energy policy, such as increasing energy access for poor communities is to be implemented, a market assessment or needs evaluation should be conducted in order to observe which services are actually required from the various energy technologies. This approach may also be accompanied with the economic benefits of the RE solution to be implemented in the rural community. The proposed energy programs that resulted from this study are as follows:

1. Biogas Energy Package (BGEP) for cooking purposes. This program was proposed because this energy service represents a high portion of energy used in rural communities.
2. Biogas Energy Package (BGEP) for local entrepreneurs. The complete low-cost biogas installation with capacity of 5-10 cows for local entrepreneur level.

Cost benefit analysis and the payback period analysis on biogas program for households are quite important for community to understand the benefit of renewable (biogas) installation before itsinstallment. In addition, the Ability to Pay and Willingness to Pay are also important tool for giving the perspective of the community economic capability to be involved in the biogas program, particularly, when they should provide their own budget for the installation, partially or totally. In this study, it was found that the rural household in Yogyakarta might provide the monthly budget of IDR 48,400 for payment of the biogas cost. The financing schemes such as subsidies, credit and combination scheme can be chosen for alternative financial action on proposed energy program.

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